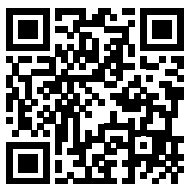


ELECTRICAL STEEL

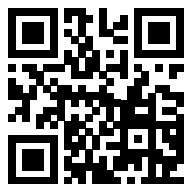
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CONTENTS

SECTION 1 Reference standards	4
NON-GRAIN-ORIENTED STEEL	5
SECTION 2 Applications of NGO steel	6
2.1 Electric motors under 1 kW	8
2.2 Electric motors from 1 to 5 kW	9
2.3 Electric motors from 5 to 100 kW	10
2.4 Electric motors from 100 to 500 kW	11
2.5 Electric motors from 500 to 1,000 kW	12
2.6 Electric motors over 1 MW	13
2.7 High-frequency EV motors from 50 to 100 kW	14
2.8 Electric generators under 1 kW	15
2.9 Electric generators from 1 to 5 kW	16
2.10 Electric generators from 5 to 100 kW	17
2.11 Electric generators from 100 to 500 kW	18
2.12 Electric generators from 500 to 1,000 kW	19
2.13 Electric generators from 1 to 5 MW	20
2.14 Electric generators from 5 to 30 MW	21
2.15 Electric generators from 30 to 100 MW	22
2.16 Electric generators from 100 to 300 MW	23
2.17 Electric generators over 300 MW	24
2.18 Transformers under 2 kVA	25
2.19 Transformers from 2 to 40 kVA	26
2.20 Transformers from 40 to 630 kVA	27
2.21 Induction coils	28
2.22 Relay switches	29
SECTION 3 NGO steel electrical insulation coatings	30
SECTION 4 NGO steel sizes	31
SECTION 5 NGO steel grades produced by NLMK	32

CONTENTS

GRAIN-ORIENTED STEEL	36
SECTION 6 Applications of GO steel	37
6.1 Transformers under 2 kVA	39
6.2 Transformers from 2 to 10 kVA	40
6.3 Transformers from 10 to 40 kVA	41
6.4 Transformers from 40 to 630 kVA	42
6.5 Transformers from 630 to 1,000 kVA	43
6.6 Transformers from 1 to 40 MVA	44
6.7 Transformers from 40 to 250 MVA	45
6.8 Transformers over 250 MVA	46
6.9 Metering current transformers	47
6.10 Line reactors	48
SECTION 7 GO steel electrical insulation coatings	49
SECTION 8 GO steel sizes	50
SECTION 9 GO steel grades produced by NLMK	51
 APPENDICES	
Appendix 1 Examples of NGO in electric motors	53
Appendix 2 Examples of NGO steel in electric generators	54
Appendix 3 Examples of electrical steel in transformers	55
Appendix 4 Examples of NGO steel in relay switches	56
Appendix 5 Examples of NGO steel in induction coils	57
Appendix 6 Examples of GOES in line reactors	58

SECTION 1

REFERENCE STANDARDS

EN 10106

Cold rolled non-oriented electrical steel strip and sheet delivered in the fully processed state (annealed)

EN 10303

Thin magnetic steel strip and sheet for use at medium frequencies

EN 10107

Grain-oriented electrical steel strip and sheet delivered in the fully processed state

EN 10342

Magnetic materials — Classification of surface insulations of electrical steel sheet, strip and laminations

GOST 33212

Non-grain oriented electrical steel strip

GOST 32482

Cold-rolled grain-oriented electrical steel sheet for transformers

GOST 21427.2

Cold-rolled isotropic electrical-sheet steel

STO 05757665-008

NLMK Corporate Standard, Cold-rolled grain-oriented (anisotropic) electrical steel sheets

NON-GRAIN-ORIENTED STEEL



SECTION 2

NGO STEEL APPLICATIONS

Industrial

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Industrial electric motors	Electric motors from 5 to 100 kW	Air blower motor	M470-50A	Д470-50A	2.3	10
	Electric motors from 100 to 500 kW	Overhead crane motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Hoist tower motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Cement mill motor	M330-50A	Д330-50A	2.6	13
Transformers	Transformers from 2 to 40 kVA	Welding machine transformer	M470-50A	Д470-50A	2.19	26
	Transformers from 40 to 630 kVA	On-site substation transformer	M400-50A	Д400-50A	2.20	27

Power generation

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Generators	Electric generators from 1 to 5 kW	Back-up gasoline generator for detached residential housing	M530-50A	Д530-50A	2.9	16
	Electric generators from 5 to 100 kW	Gasoline engine-generator set	M470-50A	Д470-50A	2.10	17
	Electric generators from 100 to 500 kW	Diesel engine-generator set	M400-50A	Д400-50A	2.11	18
	Electric generators from 500 to 1,000 kW	Generator in a small hydraulic power plant	M350-50A	Д350-50A	2.12	19
	Electric generators from 1 to 5 MW	Wind power plant generator	M330-50A	Д330-50A	2.13	20
	Electric generators from 5 to 30 MW	Gas-turbine power plant turbine generator	M310-50A	Д310-50A	2.14	21
	Electric generators from 30 to 100 MW	Hydraulic generator in an hydraulic power plant	M290-50A	Д290-50A	2.15	22
	Electric generators from 100 to 300 MW	Turbine generator in a heat power plant	M270-50A	Д270-50A	2.16	23
	Electric generators over 300 MW	Turbine generator in a nuclear power plant	M250-50A	Д250-50A	2.17	24

Household appliances

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Small appliances	Electric motors under 1 kW	Coffee maker motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 1 to 5 kW	Vacuum cleaner motor	M530-50A	Д530-50A	2.2	9
	Transformers under 2 kVA	Microwave oven transformer	M600-50A	Д600-50A	2.18	25
Large appliances	Electric motors under 1 kW	Refrigerator compressor motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 1 to 5 kW	Washing machine motor	M530-50A	Д530-50A	2.2	9
	Relay switches	Tumble dryer relay	M400-50A	Д400-50A	2.22	29
	Transformers from 2 to 40 kVA	Stovetop transformer	M470-50A	Д470-50A	2.19	26
Office appliances	Electric motors under 1 kW	Shredder motor	M600-50A	Д600-50A	2.1	8
	Transformers under 2 kVA	Photocopy machine transformer	M600-50A	Д600-50A	2.18	25

Construction

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Lighting	Relay switches	Illumination control	M400-50A	Д400-50A	2.22	29
HVAC	Electric motors from 5 to 100 kW	Ventilation compressor motor	M470-50A	Д470-50A	2.3	10
Other construction equipment	Electric motors under 1 kW	Smoke exhaust vent valve motor	M600-50A	Д600-50A	2.1	8
	Electric motors from 5 to 100 kW	Tower crane motor	M470-50A	Д470-50A	2.3	10

Transport

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Public transport	Electric motors from 100 to 500 kW	Tram motor	M400-50A	Д400-50A	2.4	11
Heavy-duty wheeled and crawler vehicles	Electric motors from 100 to 500 kW	Open-pit excavator motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Mining dump truck motor	M350-50A	Д350-50A	2.5	12
	Electric generators from 1 to 5 MW	Mining dump truck power generator	M330-50A	Д330-50A	2.13	20
Marine transport	Electric motors from 100 to 500 kW	Secondary motor in the propulsion system	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Manoeuvring system motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Icebreaker propeller motor	M330-50A	Д330-50A	2.6	13
	Electric generators from 5 to 30 MW	Transportation vessel power generator	M310-50A	Д310-50A	2.14	21
	Electric generators from 30 to 100 MW	Nuclear-powered icebreaker generator	M290-50A	Д290-50A	2.15	22
Rail transport	Electric motors from 1 to 5 kW	Train air conditioning system motor	M530-50A	Д530-50A	2.2	9
	Electric motors from 100 to 500 kW	Suburban commuter train motor	M400-50A	Д400-50A	2.4	11
	Electric motors from 500 to 1,000 kW	Shunting locomotive auxiliary motor	M350-50A	Д350-50A	2.5	12
	Electric motors over 1 MW	Mainline electric locomotive motor	M330-50A	Д330-50A	2.6	13
	Induction coils	Induction coils for magnetically levitated trains	M600-50A	Д600-50A	2.21	28

Automotive industry

Group	Equipment / device	Use cases	Recommended grades		Section No.	Page No.
			EN 10106	GOST 33212		
Vehicle propulsion units	Electric generators under 1 kW	Starter-generator	M600-50A	Д600-50A	2.8	15
	High-frequency EV motors from 50 to 100 kW	EV motors	N025-14*	—	2.7	14
Auxiliary equipment	Electric motors under 1 kW	Window lift regulator motor	M600-50A	Д600-50A	2.1	8

* As per EN 10303

SECTION 2.1

Electric motors under 1 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M600-50A Д600-50A	0.50	EN 10106	6.00	± 10	1.57	1.66	1.76
		GOST 33212	6.00	± 10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	± 10	1.60	1.69	1.77
		GOST 33212	7.00	± 10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	± 10	1.60	1.70	1.78
		GOST 33212	8.00	± 10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A Д940-50A	0.50	EN 10106	9.40	± 8	1.62	1.72	1.81
		GOST 33212	9.40	± 8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

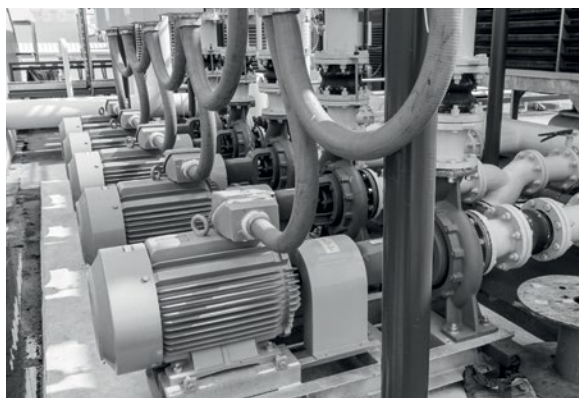
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.2

Electric motors from 1 to 5 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.3

Electric motors from 5 to 100 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.4

Electric motors from 100 to 500 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.5

Electric motors from 500 to 1,000 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M350-50A Д350-50A	0.50	EN 10106	3.50	±12	1.50	1.60	1.70
		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
– Д350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

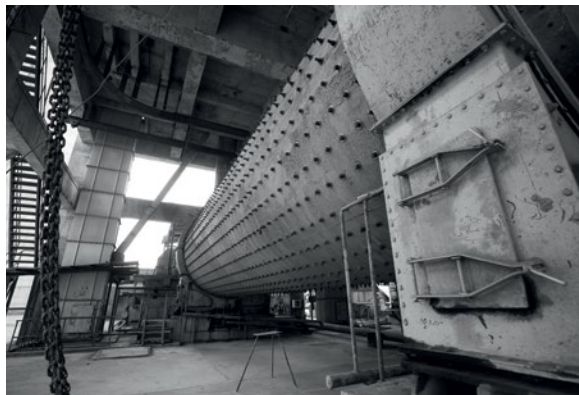
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.6

Electric motors over 1 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M330-50A Д330-50A	0.50	EN 10106	3.30	±14	1.49	1.60	1.70
		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A Д350-50A	0.50	EN 10106	3.50	±12	1.50	1.60	1.70
		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M400-65A Д400-65A	0.65	EN 10106	4.00	±14	1.52	1.62	1.72
		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
– Д330-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
– Д350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

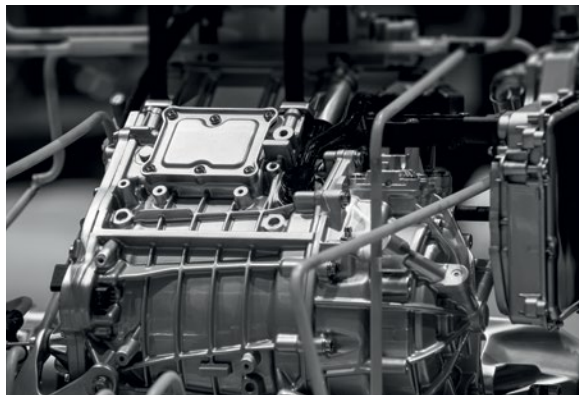
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.7

High-frequency EV motors from 50 to 100 kW



GRADES PRODUCED BY NLMK

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.6/400}$, W/kg, max	Magnetic induction			Yield strength, σ , N/mm ²
				B_{2500} , T, min	B_{5000} , T, min	B_{10000} , T, min	
N025-14***	0.25	guaranteed	13.0	1.55	1.65	1.77	400
		typical properties	12.7	1.56	1.66	1.78	410
N025-14	0.25	EN 10303	14.0	1.48	1.59	1.69	390
		typical properties	13.7	1.52	1.62	1.72	410
N027-15**	0.27	guaranteed	15.0	1.55	1.65	1.76	370
		typical properties	14.5	1.56	1.66	1.77	410
N027-15	0.27	EN 10303	15.0	1.48	1.59	1.69	370
		typical properties	14.5	1.54	1.63	1.75	410
N030-16**	0.30	guaranteed	16.0	1.55	1.65	1.76	420
		typical properties	15.5	1.57	1.66	1.77	410
N030-19	0.30	EN 10303	19.0	1.49	1.60	1.70	320
		typical properties	16.0	1.54	1.64	1.75	410
N035-19***	0.35	guaranteed	17.5	1.55	1.65	1.75	400
		typical properties	17.0	1.57	1.66	1.76	410
N035-19	0.35	EN 10303	19.0	1.49	1.60	1.70	370
		typical properties	17.2	1.54	1.64	1.75	410

Recommended by NLMK

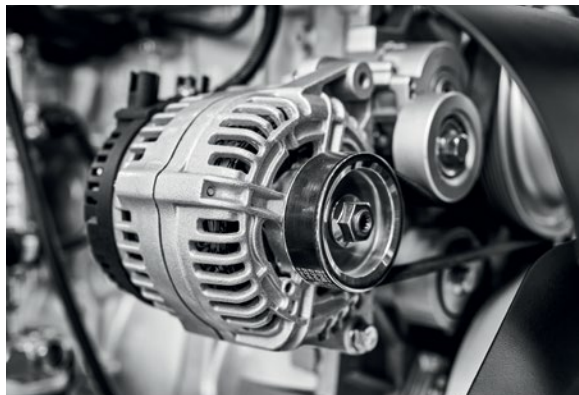
* Parameters under EN are guaranteed values

** Advanced induction grades

*** Advanced induction and lower loss grades

SECTION 2.8

Electric generators under 1 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A Д940-50A	0.50	EN 10106	9.40	±8	1.62	1.72	1.81
		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.9

Electric generators from 1 to 5 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.10

Electric generators from 5 to 100 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M470-50A Д470-50A	0.50	EN 10106	4.70	± 10	1.54	1.64	1.74
		GOST 33212	4.70	± 10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	± 10	1.56	1.65	1.75
		GOST 33212	5.30	± 10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A Д600-50A	0.50	EN 10106	6.00	± 10	1.57	1.66	1.76
		GOST 33212	6.00	± 10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	± 10	1.60	1.69	1.77
		GOST 33212	7.00	± 10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A Д470-65A	0.65	EN 10106	4.70	± 12	1.53	1.63	1.73
		GOST 33212	4.70	± 12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	± 12	1.54	1.64	1.74
		GOST 33212	5.30	± 12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

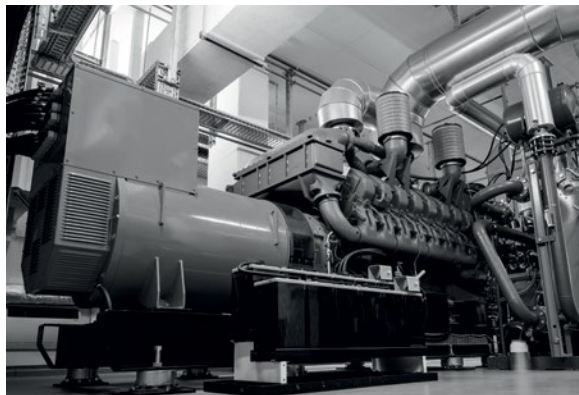
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.11

Electric generators from 100 to 500 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

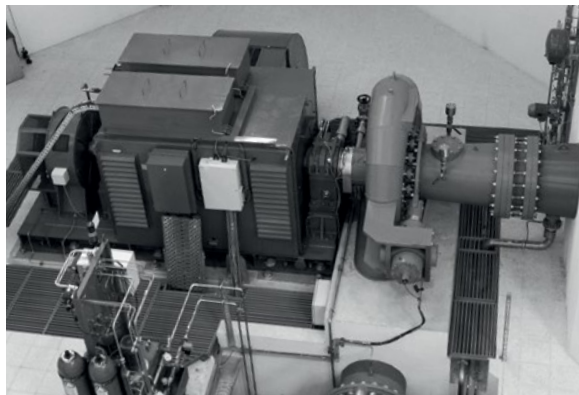
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.12

Electric generators from 500 to 1,000 kW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M350-50A Д350-50A	0.50	EN 10106	3.50	±12	1.50	1.60	1.70
		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
– Д350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.13

Electric generators from 1 to 5 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M330-50A Д330-50A	0.50	EN 10106	3.30	±14	1.49	1.60	1.70
		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A Д350-50A	0.50	EN 10106	3.50	±12	1.50	1.60	1.70
		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M400-65A Д400-65A	0.65	EN 10106	4.00	±14	1.52	1.62	1.72
		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
– Д330-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
– Д350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

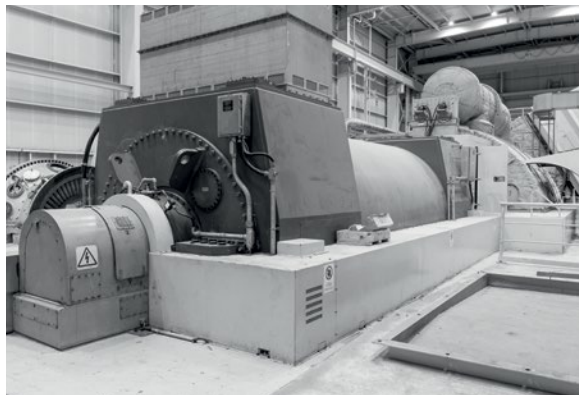
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.14

Electric generators from 5 to 30 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M310-50A D310-50A	0.50	EN 10106	3.10	± 14	1.49	1.60	1.70
		GOST 33212	3.10	± 14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A D330-50A	0.50	EN 10106	3.30	± 14	1.49	1.60	1.70
		GOST 33212	3.30	± 14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A D350-50A	0.50	EN 10106	3.50	± 12	1.50	1.60	1.70
		GOST 33212	3.50	± 14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A D400-50A	0.50	EN 10106	4.00	± 12	1.53	1.63	1.73
		GOST 33212	4.00	± 12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
– D310-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.10	± 14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
– D330-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.30	± 14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
– D350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	± 12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
– D400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	± 12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82
M330-35A D330-35A	0.35	EN 10106	3.30	± 17	1.49	1.60	1.70
		GOST 33212	3.30	± 17	1.49	–	–
		typical properties	2.98	9	1.48	1.58	1.71

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.15

Electric generators from 30 to 100 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M290-50A D290-50A	0.50	EN 10106	2.90	± 17	1.49	1.60	1.70
		GOST 33212	2.90	± 17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A D310-50A	0.50	EN 10106	3.10	± 14	1.49	1.60	1.70
		GOST 33212	3.10	± 14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A D330-50A	0.50	EN 10106	3.30	± 14	1.49	1.60	1.70
		GOST 33212	3.30	± 14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A D350-50A	0.50	EN 10106	3.50	± 12	1.50	1.60	1.70
		GOST 33212	3.50	± 14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
– D310-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.10	± 14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
– D330-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.30	± 14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
– D350-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.50	± 12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
M330-35A D330-35A	0.35	EN 10106	3.30	± 17	1.49	1.60	1.70
		GOST 33212	3.30	± 17	1.49	–	–
		typical properties	2.98	9	1.48	1.58	1.71

Recommended by NLMK

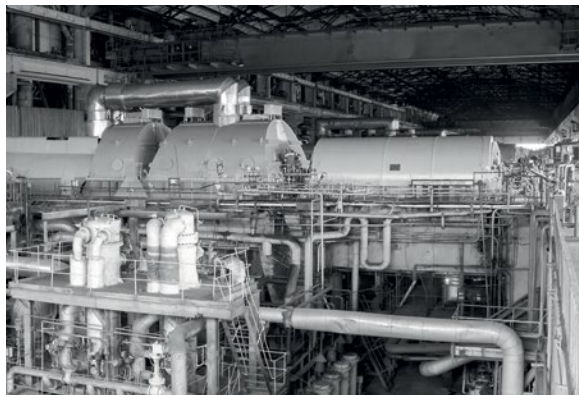
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.16

Electric generators from 100 to 300 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M270-50A Д270-50A	0.50	EN 10106	2.70	±17	1.49	1.60	1.70
		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A Д290-50A	0.50	EN 10106	2.90	±17	1.49	1.60	1.70
		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A Д310-50A	0.50	EN 10106	3.10	±14	1.49	1.60	1.70
		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A Д330-50A	0.50	EN 10106	3.30	±14	1.49	1.60	1.70
		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
– Д310-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
– Д330-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
M270-35A Д270-35A	0.35	EN 10106	2.70	±17	1.49	1.60	1.70
		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75

Recommended by NLMK

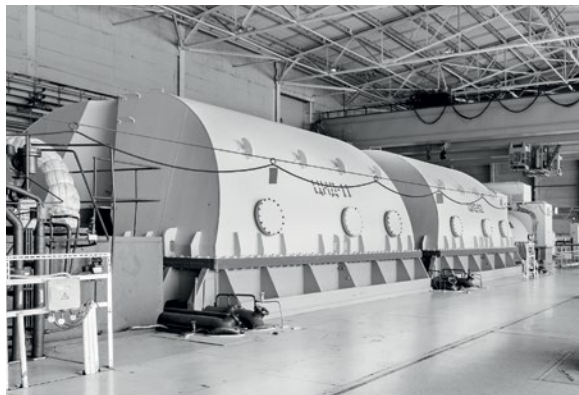
* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.17

Electric generators over 300 MW



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M250-50A D250-50A	0.50	EN 10106	2.50	±17	1.49	1.60	1.70
		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.46	11	1.56	1.65	1.77
M270-50A D270-50A	0.50	EN 10106	2.70	±17	1.49	1.60	1.70
		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A D290-50A	0.50	EN 10106	2.90	±17	1.49	1.60	1.70
		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A D310-50A	0.50	EN 10106	3.10	±14	1.49	1.60	1.70
		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
– D310-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
M250-35A D250-35A	0.35	EN 10106	2.50	±17	1.49	1.60	1.70
		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.45	11	1.54	1.64	1.76
M270-35A D270-35A	0.35	EN 10106	2.70	±17	1.49	1.60	1.70
		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.18

Transformers under 2 kVA



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A Д940-50A	0.50	EN 10106	9.40	±8	1.62	1.72	1.81
		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.19

Transformers from 2 to 40 kVA



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.20

Transformers from 40 to 630 kVA



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M400-50A Д400-50A	0.50	EN 10106	4.00	± 12	1.53	1.63	1.73
		GOST 33212	4.00	± 12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	± 10	1.54	1.64	1.74
		GOST 33212	4.70	± 10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	± 10	1.56	1.65	1.75
		GOST 33212	5.30	± 10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	± 12	1.53	1.63	1.73
		GOST 33212	4.70	± 12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	± 12	1.54	1.64	1.74
		GOST 33212	5.30	± 12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	± 12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 2.21

Induction coils



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M600-50A Д600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A Д700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A Д800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A Д940-50A	0.50	EN 10106	9.40	±8	1.62	1.72	1.81
		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

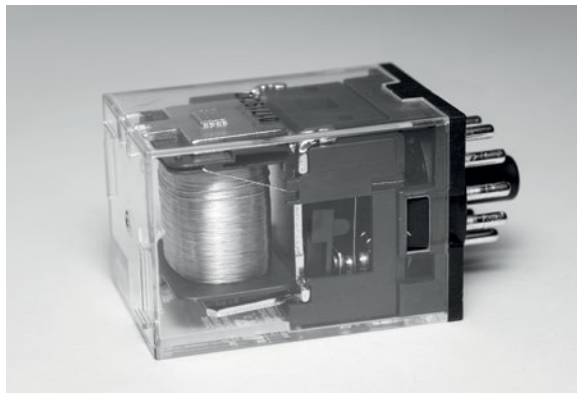
Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

SECTION 2.22

Relay switches



GRADES PRODUCED BY NLMK

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M400-50A Д400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A Д470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A Д530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M470-65A Д470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A Д530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82
– Д400-50AP	0.50	EN 10106***	–	–	–	–	–
		GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Grade not present in EN 10106

SECTION 3

NGO STEEL ELECTRIC INSULATION COATING

Type under EN 10342	Type under GOST 33212	Grade under GOST 21427	Thickness, μm	Resistance factor, $\text{Ohm} \times \text{cm}^2, \text{min}^*$	Thermal resistance	Freon resistance	Stampability	Weldability
EN-5-N EN-5-P	TШ	TШ1	≤ 1.0	1	450°C, 2 hrs in air	good	good	good
			0.5-1.5	5	750°C, 2.5 hrs in protective atmosphere	good	good	good
EC-3	HШ	HШ1	0.5-1.5	1.5	200°C, 24 hrs in air	good	excellent	adequate
EC-6	HШ	HШ40	4.0-7.0	40	200°C, 24 hrs in air	good	good	adequate

* Average of two sides

SECTION 4

NGO STEEL DIMENSIONAL MIX

- **Thickness:** 0.25; 0.27; 0.30; 0.35; 0.50; 0.65 mm
- **Width:**
coils from 500 to 1,200 mm,
bands from 90 to 500 mm
- **Coil internal diameter:** 500 mm
- **Coil weight:** from 3 to 15 t

TOLERANCES

Nominal thickness, mm	EN 10303				EN 10106			GOST 33212			
	0.25	0.27	0.30	0.35	0.35	0.50	0.65	0.27	0.35	0.50	0.65
Steel thickness deviation, %, max	–	–	–	–	±8	±8	±6	–	–	–	–
Steel thickness deviation, mm, max	±0.025	±0.027	±0.030	±0.030	–	–	–	±0.020	±0.030	±0.040	±0.040
Transverse thickness variation, mm	≤0.020	≤0.020	≤0.020	≤0.020	≤0.020	≤0.020	≤0.030	≤0.020	≤0.020	≤0.020	≤0.030
Longitudinal thickness variation, %, max	≤10	≤10	≤8	≤8	≤8	≤8	≤6	–	–	–	–
Longitudinal thickness variation, mm, max	–	–	–	–	–	–	–	≤0.020	≤0.030	≤0.040	≤0.040
Distortion factor, %, per 1 metre*	–	–	–	–	≤2.0	–	–	≤1.5	–	–	–
Camber, mm, per 1 metre	–	–	–	–	–	–	–	–	–	–	–
rolled steel width >150 mm	≤1.0	–	–	–	≤0.5	–	–	≤0.5	–	–	–
rolled steel width 30–150 mm	–	–	–	–	≤1.0	–	–	–	–	–	–
Residual curvature, mm	–	–	–	–	≤35	–	–	≤35	–	–	–
Internal stress, mm, per 1 metre	–	–	–	–	≤2	–	–	≤2	–	–	–
Burr height, mm, max	≤0.030	–	–	–	–	–	–	≤0.020	–	–	–

Nominal width, mm	EN 10303			EN 10106/ GOST 33212				
	<150	150</>500	500</>1250	≤150	150</>300	300</>600	600</>1000	1000</>1250
Maximum width deviation*, mm	0/+0.4	0/+0.6	0/+1.5	0/+0.2	0/+0.3	0/+0.5	0/+1.0	0/+1.5

* rolled steel width >100 mm

** rolled steel width >150 mm

SECTION 5

NGO STEEL GRADES PRODUCED BY NLMK

STANDARD GRADES UNDER EN 10106 AND GOST 33212

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M250-35A	0.35	EN 10106	2.50	±17	1.49	1.60	1.70
D250-35A		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.45	11	1.54	1.64	1.76
M270-35A	0.35	EN 10106	2.70	±17	1.49	1.60	1.70
D270-35A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.62	10	1.54	1.63	1.75
M250-50A	0.50	EN 10106	2.50	±17	1.49	1.60	1.70
D250-50A		GOST 33212	2.50	±17	1.49	–	–
		typical properties	2.46	11	1.56	1.65	1.77
M270-50A	0.50	EN 10106	2.70	±17	1.49	1.60	1.70
D270-50A		GOST 33212	2.70	±17	1.49	–	–
		typical properties	2.58	11	1.55	1.64	1.77
M290-50A	0.50	EN 10106	2.90	±17	1.49	1.60	1.70
D290-50A		GOST 33212	2.90	±17	1.49	–	–
		typical properties	2.75	10	1.54	1.63	1.75
M310-50A	0.50	EN 10106	3.10	±14	1.49	1.60	1.70
D310-50A		GOST 33212	3.10	±14	1.49	–	–
		typical properties	2.99	9	1.52	1.62	1.75
M330-50A	0.50	EN 10106	3.30	±14	1.49	1.60	1.70
D330-50A		GOST 33212	3.30	±14	1.49	–	–
		typical properties	3.17	9	1.52	1.61	1.74
M350-50A	0.50	EN 10106	3.50	±12	1.50	1.60	1.70
D350-50A		GOST 33212	3.50	±14	1.50	–	–
		typical properties	2.98	9	1.52	1.62	1.75
M400-50A	0.50	EN 10106	4.00	±12	1.53	1.63	1.73
D400-50A		GOST 33212	4.00	±12	1.53	–	–
		typical properties	3.60	9	1.58	1.67	1.79
M470-50A	0.50	EN 10106	4.70	±10	1.54	1.64	1.74
D470-50A		GOST 33212	4.70	±10	1.54	–	–
		typical properties	4.14	5	1.63	1.72	1.83
M530-50A	0.50	EN 10106	5.30	±10	1.56	1.65	1.75
D530-50A		GOST 33212	5.30	±10	1.56	–	–
		typical properties	4.92	5	1.63	1.72	1.83
M600-50A	0.50	EN 10106	6.00	±10	1.57	1.66	1.76
D600-50A		GOST 33212	6.00	±10	1.57	–	–
		typical properties	4.00	6	1.62	1.71	1.82
M700-50A	0.50	EN 10106	7.00	±10	1.60	1.69	1.77
D700-50A		GOST 33212	7.00	±10	1.60	–	–
		typical properties	5.39	4	1.67	1.75	1.86
M800-50A	0.50	EN 10106	8.00	±10	1.60	1.70	1.78
D800-50A		GOST 33212	8.00	±10	1.60	–	–
		typical properties	5.40	4	1.67	1.75	1.86
M940-50A	0.50	EN 10106	9.40	±8	1.62	1.72	1.81
D940-50A		GOST 33212	9.40	±8	1.62	–	–
		typical properties	5.21	4	1.66	1.74	1.85

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

STANDARD GRADES UNDER EN 10106 AND GOST 33212

Grade EN 10106 GOST 33212	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
M400-65A	0.65	EN 10106	4.00	±14	1.52	1.62	1.72
D400-65A		GOST 33212	4.00	±14	1.52	–	–
		typical properties	3.29	8	1.56	1.66	1.78
M470-65A	0.65	EN 10106	4.70	±12	1.53	1.63	1.73
D470-65A		GOST 33212	4.70	±12	1.53	–	–
		typical properties	3.85	9	1.61	1.70	1.81
M530-65A	0.65	EN 10106	5.30	±12	1.54	1.64	1.74
D530-65A		GOST 33212	5.30	±12	1.54	–	–
		typical properties	4.77	4	1.62	1.71	1.82

HIGH-PERMEABILITY GRADES UNDER GOST 33212

Used in electric motors with high torque and power generators with stricter requirements to size.

The desired properties are achieved through improved magnetic induction.

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.5/50}$, W/kg, max	Anisotropy of specific magnetic losses, $\Delta P_{1.5/50}$, %, max	Magnetic induction		
					B_{2500} , T, min	B_{5000} , T, min**	B_{10000} , T, min**
D310-50AP	0.50	GOST 33212	3.10	±14	1.55	–	–
		typical properties	2.84	10	1.59	1.69	1.81
D330-50AP	0.50	GOST 33212	3.30	±14	1.55	–	–
		typical properties	3.05	9	1.61	1.70	1.81
D350-50AP	0.50	GOST 33212	3.50	±12	1.59	–	–
		typical properties	3.07	10	1.61	1.70	1.81
D400-50AP	0.50	GOST 33212	4.00	±12	1.61	–	–
		typical properties	3.39	9	1.62	1.71	1.82

HIGH-FREQUENCY GRADES UNDER EN 10303

Used in EV motors that operate at or above 400 Hz. The steel is purposefully designed to achieve optimal losses at those specific frequencies.

Grade	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.0/400}$, W/kg, max	Magnetic induction B_{2500} , T, min	Yield strength, σ_r , N/mm ²	
					B_{5000} , T, min	B_{10000} , T, min
N025-14****	0.25	guaranteed	13.0	1.55	1.65	1.77
		typical properties	12.7	1.56	1.66	1.78
N025-14	0.25	EN 10303	14.0	1.48	1.59	1.69
		typical properties	13.7	1.52	1.62	1.72
N027-15***	0.27	guaranteed	15.0	1.55	1.65	1.76
		typical properties	14.5	1.56	1.66	1.77
N027-15	0.27	EN 10303	15.0	1.48	1.59	1.69
		typical properties	14.5	1.54	1.63	1.75
N030-16***	0.30	guaranteed	16.0	1.55	1.65	1.76
		typical properties	15.5	1.57	1.66	1.77
N030-19	0.30	EN 10303	19.0	1.49	1.60	1.70
		typical properties	16.0	1.54	1.64	1.75
N035-19****	0.35	guaranteed	17.5	1.55	1.65	1.75
		typical properties	17.0	1.57	1.66	1.76
N035-19	0.35	EN 10303	19.0	1.49	1.60	1.70
		typical properties	17.2	1.54	1.64	1.75

* Parameters under EN and GOST are guaranteed values

** Not specified under GOST 33212

*** Advanced induction grades

****Advanced induction and lower loss grades

GUARANTEED PROPERTIES UNDER GOST 21427

Nominal thickness, mm	Grade	Specific magnetic losses, $P_{1,5/50}$, W/kg, max	Magnetic induction, B_{5000} , T, min	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %, max	Anisotropy of magnetic induction, ΔB_{5000} , T, max	Stacking factor*, min	Bends, min
0.35	2413	2.5	1.50	±18	0.16	0.95	2
	2412	2.7	1.50	±18	0.16	0.95	2
	2411	3.0	1.50	±18	0.16	0.95	2
0.50	2414	2.7	1.49	±18	0.16	0.96 (0.95)	1
	2413	2.9	1.50	±18	0.16	0.96 (0.95)	1
	2412	3.1	1.50	±18	0.16	0.96 (0.95)	1
	2411	3.6	1.49	±18	0.16	0.96 (0.95)	1
	2312	3.8	1.58	±14	0.16	0.96 (0.95)	2
	2216	4.0	1.60	±12	0.13	0.96 (0.95)	3
	2215	4.5	1.64	±12	0.13	0.96 (0.95)	3
	2214	4.8	1.62	±12	0.13	0.96 (0.95)	3
	2213	5.0	1.65	±12	0.13	0.96 (0.95)	3
	2212	5.0	1.60	±12	0.13	0.96 (0.95)	3
	2211	5.5	1.56	±12	0.13	0.96 (0.95)	3
	2112	6.0	1.62	±12	0.13	0.96 (0.95)	–
0.50	2111	7.0	1.60	±12	0.13	0.96 (0.95)	–
	2013	6.5	1.65	±10	0.13	0.96 (0.95)	–
	2012	7.0	1.62	±10	0.13	0.96 (0.95)	–
	2011	8.0	1.60	±10	0.13	0.96 (0.95)	–

* For coated steel: Group A (Group B)

GUARANTEED MECHANICAL PROPERTIES UNDER GOST 21427

Grade	Ultimate tensile strength, σ_B , N/mm ²	Relative elongation, δ_4 , %	Hardness, HV ₅
2411–2414	370–600	15–30	140–210
2312	330–470	20–35	120–160
2216–2211	300–450	20–35	120–145
2111–2112	300–450	20–35	110–145
2011–2013	290–490	15–35	120–160

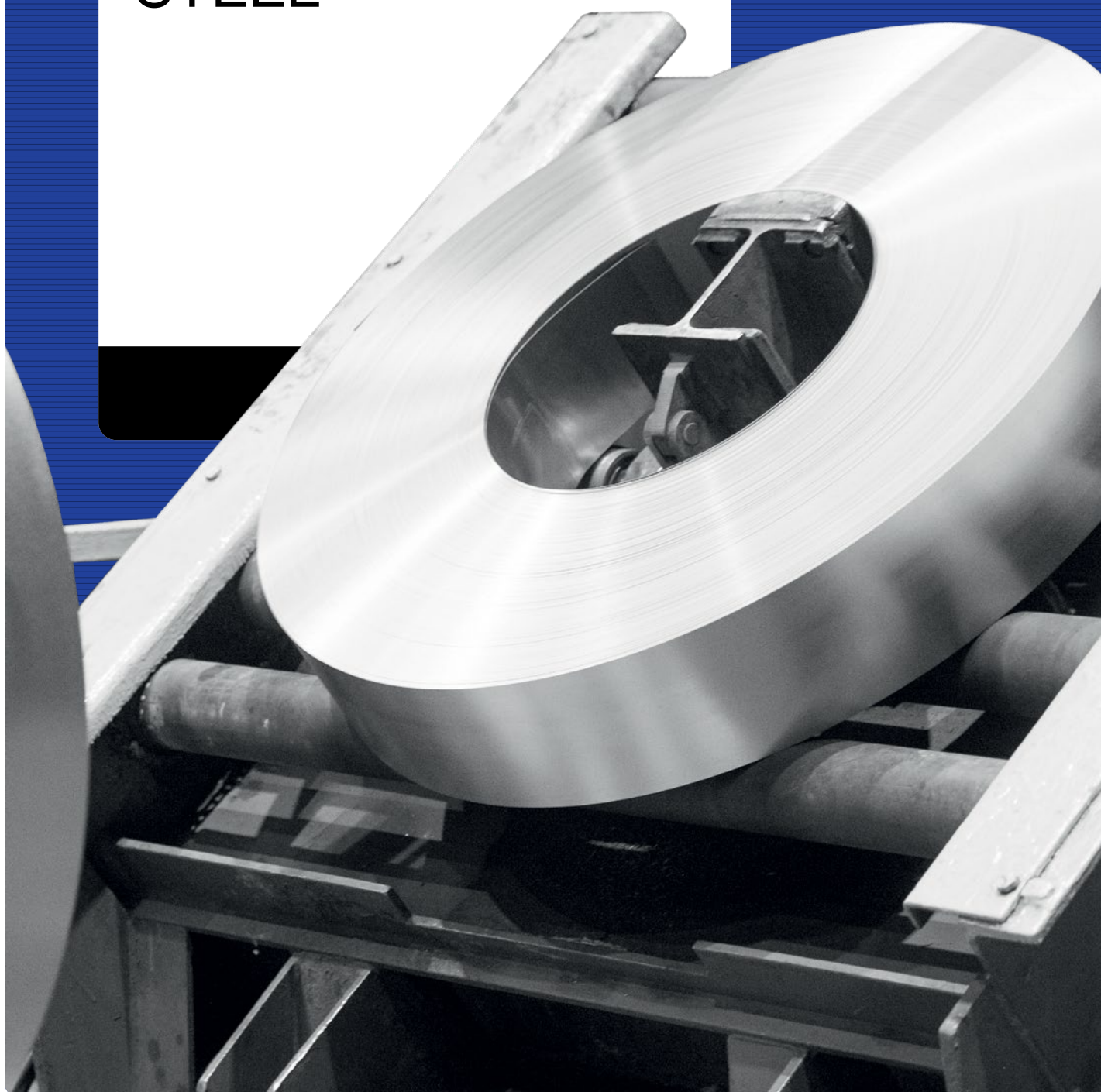
TYPICAL MAGNETIC AND MECHANICAL PROPERTIES UNDER GOST 21427

Nominal thickness, mm	Grade	Specific magnetic losses, $P_{1,0/50}$, W/kg	Specific magnetic losses, $P_{1,5/50}$, W/kg	Anisotropy of specific magnetic losses, $\Delta P_{1,5/50}$, %	Magnetic induction, B_{2500} , T	Magnetic induction, B_{5000} , T	Magnetic induction, B_{10000} , T	Yield strength, σ_T , N/mm ²	Ultimate tensile strength, σ_B , N/mm ²	Relative elongation, δ_4 , %	Hardness, HV ₅
0.35	2412	0.97	2.29	9	1.54	1.64	1.76	403	516	16	200
0.50	2412	1.24	2.97	8	1.52	1.61	1.74	390	514	20	203
	2411	1.3	3.04	8	1.52	1.61	1.74	384	506	19	201
	2312	1.59	3.66	8	1.6	1.69	1.81	246	407	29	137
	2212	1.83	4.11	6	1.63	1.71	1.82	226	390	31	127
	2112	2.13	4.73	4	1.65	1.73	1.85	274	404	30	127
	2012	2.58	5.61	4	1.64	1.7	1.855	283	404	31	128

ALIGNMENT OF FULLY PROCESSED NGO STEELS ACROSS DIFFERENT STANDARDS

	Europe				Russia			USA			India				
	EN 10106				GOST 33212			GOST 21427			ASTM A677		IS 648		
Nominal thickness, mm	Grade	P _{1,5/50} , W/kg	B ₂₅₀₀ , T	B ₅₀₀₀ , T	Grade	P _{1,5/50} , W/kg	B ₂₅₀₀ , T	Grade	P _{1,5/50} , W/kg	B ₂₅₀₀ , T	Grade	P _{1,5/50} , W/kg	Grade	P _{1,5/50} , W/kg	B ₂₅₀₀ , T
0.35	M250-35A	2.50	1.49	1.60	Д250-35A	2.50	1.49	2413	2.50	1.50	36F145	2.53	35C250	2.50	1.49
	M270-35A	2.70	1.49	1.60	Д270-35A	2.70	1.49	2412	2.70	1.50	36F155	2.70	35C270	2.70	1.49
	—	—	—	—	—	—	—	—	—	—	36F165	2.88	—	—	—
	—	—	—	—	—	—	—	—	—	—	36F175	3.05	—	—	—
	M330-35A	3.30	1.49	1.60	Д330-35A	3.30	1.49	—	—	—	36F185	3.22	35C330	3.30	1.49
	—	—	—	—	—	—	—	—	—	—	—	—	35C360	3.60	1.49
0.50	M250-50A	2.50	1.49	1.60	Д250-50A	2.50	1.49	—	—	—	—	—	50C250	2.50	1.49
	M270-50A	2.70	1.49	1.60	Д270-50A	2.70	1.49	2414	2.70	1.49	—	—	50C270	2.70	1.49
	M290-50A	2.90	1.49	1.60	Д290-50A	2.90	1.49	2413	2.90	1.50	47F165	2.88	50C290	2.90	1.49
	M310-50A	3.10	1.49	1.60	Д310-50A	3.10	1.49	2412	3.10	1.50	—	—	50C310	3.10	1.49
	—	—	—	—	—	—	—	—	—	—	47F180	3.14	—	—	—
	M330-50A	3.30	1.49	1.60	Д330-50A	3.30	1.49	—	—	—	47F190	3.31	50C330	3.30	1.49
	M350-50A	3.50	1.50	1.60	Д350-50A	3.50	1.50	—	—	—	47F200	3.48	50C350	3.50	1.50
	—	—	—	—	—	—	—	2411	3.60	1.49	47F210	3.66	—	—	—
	—	—	—	—	—	—	—	2312	3.80	1.58	—	—	—	—	—
	M400-50A	4.00	1.53	1.63	Д400-50A	4.00	1.53	2216	4.00	1.60	47F240	4.18	50C400	4.00	1.53
	—	—	—	—	—	—	—	2215	4.50	1.64	—	—	—	—	—
	M470-50A	4.70	1.54	1.64	Д470-50A	4.70	1.54	—	—	—	—	—	50C470	4.70	1.54
	—	—	—	—	—	—	—	2214	4.80	1.62	47F280	4.87	—	—	—
	—	—	—	—	—	—	—	2213	5.00	1.65	—	—	—	—	—
	—	—	—	—	—	—	—	2212	5.00	1.60	—	—	—	—	—
	M530-50A	5.30	1.56	1.65	Д530-50A	5.30	1.56	—	—	—	—	—	50C530	5.30	1.56
	—	—	—	—	—	—	—	2211	5.50	1.56	—	—	—	—	—
	M600-50A	6.00	1.57	1.66	Д600-50A	6.00	1.57	2112	6.00	1.62	—	—	50C600	6.00	1.57
	M700-50A	7.00	1.60	1.69	Д700-50A	7.00	1.60	2111	7.00	1.60	47F400	6.97	50C700	7.00	1.60
	—	—	—	—	—	—	—	2013	6.50	1.65	—	—	—	—	—
	—	—	—	—	—	—	—	2012	7.00	1.62	—	—	—	—	—
	M800-50A	8.00	1.60	1.70	Д800-50A	8.00	1.60	2011	8.00	1.60	47F450	7.84	50C800	8.00	1.60
	—	—	—	—	—	—	—	—	—	—	—	—	50C900	9.00	1.61
	M940-50A	9.40	1.62	1.72	Д940-50A	9.40	1.62	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	50C1000	10.00	1.62
0.65	M400-65A	4.00	1.52	1.62	Д400-65A	4.00	1.52	—	—	—	64F235	4.09	65C400	4.00	1.52
	M470-65A	4.70	1.53	1.63	Д470-65A	4.70	1.53	—	—	—	—	—	65C470	4.70	1.53
	M530-65A	5.30	1.54	1.64	Д530-65A	5.30	1.54	—	—	—	—	—	65C530	5.30	1.54

GRAIN-ORIENTED STEEL



SECTION 6

GRAIN-ORIENTED STEEL APPLICATIONS

Electricity generation

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Transformers for power stations	Transformers from 1 to 40 MVA	Transformers for wind power plants	M95-27Pb	T95-27D	6.6	44
	Transformers from 40 to 250 MVA	Transformers for gas-turbine power plants	M90-23Pb	NV23S-90L*	6.7	45
	Transformers over 250 MVA	Transformers for nuclear power plants	M85-23Pb	NV23S-85L*/**	6.8	46

Electric power transmission

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Metering transformers for transmission substations	Metering transformers	Current transformers for relay protection and metering systems	M110-30P	T111-30S	6.9	47
Transformers for transmission substations	Transformers from 1 to 40 MVA	Transformers for substations rated for voltage up to 110 kV	M95-27Pb	T95-27D	6.6	44
	Transformers from 40 to 250 MVA	Transformers for substations rated for voltage up to 500 kV	M90-23Pb	NV23S-90L*/**	6.7	45
	Transformers over 250 MVA	Autotransformers for grid interconnections	M85-23Pb	NV23S-85L*/**	6.8	46
Line reactors for transmission substations	Line reactors	Controlled shunt reactors for transformer substations	M85-23Pb	NV23S-85L*/**	6.10	48

Electrical power distribution

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Transformers for distribution substations and end users	Transformers under 2 kVA	Transformers for high pressure water jets	M130-30S	T130-30S	6.1	39
	Transformers from 2 to 10 kVA	Voltage stabilizing transformers	M120-30S	T120-30S	6.2	40
	Transformers from 10 to 40 kVA	Transformers for power-system automation circuits	M110-30P	T111-30S	6.3	41
	Transformers from 40 to 630 kVA	Transformers for thyristor converters in electrical drives	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for industrial on-site substations	M100-30Pb	T100-30D**	6.5	43
Line reactors for distribution substations	Line reactors	Shell-type current limiting reactors against short circuits	M85-23Pb	NV23S-85L*/**	6.10	48

* Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLTK's STO 05757665-008

** The production process for these GOST grades is at the R&D stage, trial batches are being produced

Transport

Group	Equipment / Device	Use cases	Recommended grades		Section No.	Page No.
			EN 10107	GOST 32482		
Electric public transit	Transformers from 40 to 630 kVA	Transformers for trackside propulsion substations in subway networks	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for master propulsion substations in subway networks	M100-30Pb	T100-30D**	6.5	43
Cars, heavy-duty wheeled and crawler vehicles	Transformers under 2 kVA	Transformers for EV on-board control systems	M130-30S	T130-30S	6.1	39
	Transformers from 2 to 10 kVA	Transformers for EV charging stations	M120-30S	T120-30S	6.2	40
	Transformers from 40 to 630 kVA	Transformers for excavator electric systems	M105-30P	T105-30D	6.4	42
Marine transport	Transformers from 10 to 40 kVA	Transformers for lighting systems	M110-30P	T111-30S	6.3	41
	Transformers from 40 to 630 kVA	Transformers for HVAC	M105-30P	T105-30D	6.4	42
	Transformers from 630 to 1,000 kVA	Transformers for steering systems	M100-30Pb	T100-30D**	6.5	43
	Transformers from 1 to 40 MVA	Transformers for main drivetrain	M95-27Pb	T95-27D	6.6	44
Rail transport	Transformers from 630 to 1,000 kVA	Transformers for trackside propulsion substations in mainline networks	M100-30Pb	T100-30D**	6.5	43
	Transformers from 1 to 40 MVA	Transformers for master propulsion substations in mainline networks	M95-27Pb	T95-27D	6.6	44

* Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

SECTION 6.1

Transformers under 2 kVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M130-30S	0.30	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

 Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.2

Transformers from 2 to 10 kVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M120-30S	0.30	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M120-27S	0.27	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M130-30S	0.30	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

 Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.3

Transformers from 10 to 40 kVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M110-30P	0.30	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.09	1.88
M110-23S	0.23	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	0.27	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S	0.27	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M120-30S	0.30	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M130-30S	0.30	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

 Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.4

Transformers from 40 to 630 kVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M105-30P	0.30	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
-	0.27	EN 10107**	-	-
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M110-23S	0.23	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	0.27	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M110-30P	0.30	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** Not specified by EN 10107

SECTION 6.5

Transformers from 630 to 1,000 kVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M100-30Pb	0.30	EN 10107	1.00	1.88
T100-30D**		GOST 32482	1.00	1.87
		typical properties	–	–
M100-23P	0.23	EN 10107	1.00	1.88
T100-23D		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P	0.27	EN 10107	1.00	1.88
T100-27D		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
–	0.27	EN 10107***	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M105-30P	0.30	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
M110-23S	0.23	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P	0.27	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M110-30P	0.30	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Not specified by EN 10107

SECTION 6.6

Transformers from 1 to 40 MVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M95-27Pb T95-27D	0.27	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.95	1.88
M95-23P T95-23D	0.23	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M100-23P T100-23D	0.23	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P T100-27D	0.27	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb T100-30D**	0.30	EN 10107	1.00	1.88
		GOST 32482	1.00	1.87
		typical properties	–	–
– T105-27S	0.27	EN 10107***	–	–
		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M105-30P T105-30D	0.30	EN 10107	1.05	1.88
		GOST 32482	1.05	1.87
		typical properties	1.04	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Not specified by EN 10107

SECTION 6.7

Transformers from 40 to 250 MVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M90-23Pb NV23S-90L	0.23	EN 10107	0.90	1.88
		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P T95-23D	0.23	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb T95-27D	0.27	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.94	1.88
M100-23P T100-23D	0.23	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M100-27P T100-27D	0.27	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb T100-30D**	0.30	EN 10107	1.00	1.88
		GOST 32482	1.00	1.87
		typical properties	–	–

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 6.8

Transformers over 250 MVA



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M85-23Pb	0.23	EN 10107	0.85	1.88
NV23S-85L**		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb	0.23	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	0.23	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb	0.27	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.945	1.88

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 6.9

Metering transformer



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M110-30P T111-30S	0.30	EN 10107	1.10	1.88
		GOST 32482	1.11	1.87
		typical properties	1.07	1.87
M110-23S T110-23S	0.23	EN 10107	1.10	1.78
		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
M110-27P T110-27S	0.27	EN 10107	1.10	1.88
		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S T120-27S	0.27	EN 10107	1.20	1.78
		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M120-30S T120-30S	0.30	EN 10107	1.20	1.78
		GOST 32482	1.20	1.86
		typical properties	1.12	1.87

Recommended by NLMK

* Parameters under EN and GOST are guaranteed values

SECTION 6.10

Line reactors



GRADES PRODUCED BY NLMK

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M85-23Pb	0.23	EN 10107	0.85	1.88
NV23S-85L**		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb	0.23	EN 10107	0.90	1.88
NV23S-90L		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P	0.23	EN 10107	0.95	1.88
T95-23D		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M95-27Pb	0.27	EN 10107	0.95	1.88
T95-27D		GOST 32482	0.95	1.87
		typical properties	0.945	1.88

Recommended by NLMK

* Parameters under EN, STO and GOST are guaranteed values

** The production process for these GOES grades is at the R&D stage, trial batches are being produced

*** Grades with low magnetic losses supplied in thickness of 0.23 mm are not specified by GOST 32482; the Catalogue lists a similar designation from NLMK's STO 05757665-008

SECTION 7

GO STEEL ELECTRIC INSULATION COATING

Supplied as coils, bands or sheets with heat-resistant insulation coating “ЭТ” under GOST 32482-2013 (equivalent to the electrical insulation coating under EN 10342).

Coating type	Base	Colour	Resistance factor, $\Omega\text{m}\times\text{cm}^2$	Thermal resistance
ЭТ	Silicates, phosphates, chromates	Grey or brown grey	≥ 20	$(840\pm 10)^\circ\text{C}$, 3 h, in neutral atmosphere

SECTION 8

GO STEEL

DIMENSIONAL MIX

- **Thickness:** 0.23; 0.27; 0.30 mm
- **Width:**
bands — 20 to 499 mm
sheets — 914 to 960 mm;
coils — 650 to 1020 mm
- **Coil internal diameter:** 500 mm
- **Coil weight:** 3 to 5 tonnes

TOLERANCES

Nominal thickness, mm	EN 10107			GOST 32482		
	0.23	0.27	0.30	0.23	0.27	0.30
Max steel thickness deviation, mm	±0.025	±0.03	±0.03	±0.02	±0.02	±0.02
Max weld thickness deviation, mm	≤0.05	≤0.05	≤0.05	≤0.02	≤0.02	≤0.02
Transverse thickness variation*, mm	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02
Longitudinal thickness variation per 1,500 mm of length, mm	≤0.03	≤0.03	≤0.03	≤0.02	≤0.02	≤0.02
Burrs, mm	≤0.025	≤0.025	≤0.025	≤0.015	≤0.015	≤0.015
Min stacking factor	0.945	0.950	0.955	0.945	0.950	0.955
Non-flatness height to length ratio, %	≤1.5			≤1.5		
Camber per 1,500 mm (EN) / 1,000 mm (GOST) of length*, mm	≤0.05			≤0.05		
Residual stresses (cutting line gap)**, mm	-			≤1.0		
No. of folds	≥1			≥1		

Nominal width, mm	EN 10107				GOST 32482			
	≤150	150</=400	400</=750	>750	≤150	150</=400	400</=750	>750
Maximum width deviations, mm	0</=0.02	0</=0.03	0</=0.05	0</=0.06	0</=0.02	0</=0.03	0</=0.05	0</=0.06

* For widths over 150 mm

** For widths over 500 mm

Steel produced to other specifications is available by custom order, subject to additional approval.

SECTION 9

GO STEEL GRADES PRODUCED BY NLMK

STANDARD GRADES

Grade EN 10107 GOST 32482	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M110-23S	0.23	EN 10107	1.10	1.78
T110-23S		GOST 32482	1.10	1.85
		typical properties	1.03	1.88
–	0.27	EN 10107**	–	–
T105-27S		GOST 32482	1.05	1.87
		typical properties	1.02	1.88
M110-27P	0.27	EN 10107	1.10	1.88
T110-27S		GOST 32482	1.10	1.86
		typical properties	1.07	1.87
M120-27S	0.27	EN 10107	1.20	1.78
T120-27S		GOST 32482	1.20	1.84
		typical properties	1.13	1.86
M105-30P	0.30	EN 10107	1.05	1.88
T105-30D		GOST 32482	1.05	1.87
		typical properties	1.04	1.87
M110-30P	0.30	EN 10107	1.10	1.88
T111-30S		GOST 32482	1.11	1.87
		typical properties	1.07	1.87
M120-30S	0.30	EN 10107	1.20	1.78
T120-30S		GOST 32482	1.20	1.86
		typical properties	1.12	1.87
M130-30S	0.30	EN 10107	1.30	1.78
T130-30S		GOST 32482	1.30	1.84
		typical properties	1.26	1.85

* Parameters under EN and GOST are guaranteed values

** Not specified by EN 10107

HIGH-PERMEABILITY GRADES UNDER EN 10107, GOST 32482 AND STO 05757665-008

Grade EN 10107 GOST 32482***	Nominal thickness, mm	Values*	Specific magnetic losses, $P_{1.7/50}$, W/kg, max	Magnetic induction, B_{500} , T, min
M85-23Pb NV23S-85L**	0.23	EN 10107	0.85	1.88
		STO 05757665-008***	0.85	1.88
		typical properties	0.84	1.88
M90-23Pb NV23S-90L	0.23	EN 10107	0.90	1.88
		STO 05757665-008***	0.90	1.88
		typical properties	0.89	1.88
M95-23P T95-23D	0.23	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.93	1.88
M100-23P T100-23D	0.23	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.98	1.88
M95-27Pb T95-27D	0.27	EN 10107	0.95	1.88
		GOST 32482	0.95	1.87
		typical properties	0.945	1.88
M100-27P T100-27D	0.27	EN 10107	1.00	1.88
		GOST 32482	1.00	1.86
		typical properties	0.99	1.88
M100-30Pb T100-30D**	0.30	EN 10107	1.00	1.88
		GOST 32482	1.00	1.87
		typical properties	–	–

* Parameters under EN and GOST are guaranteed values

** Технология производства данных марок трансформаторной стали находится в стадии разработки, продукция производится в опытно-промышленных объемах

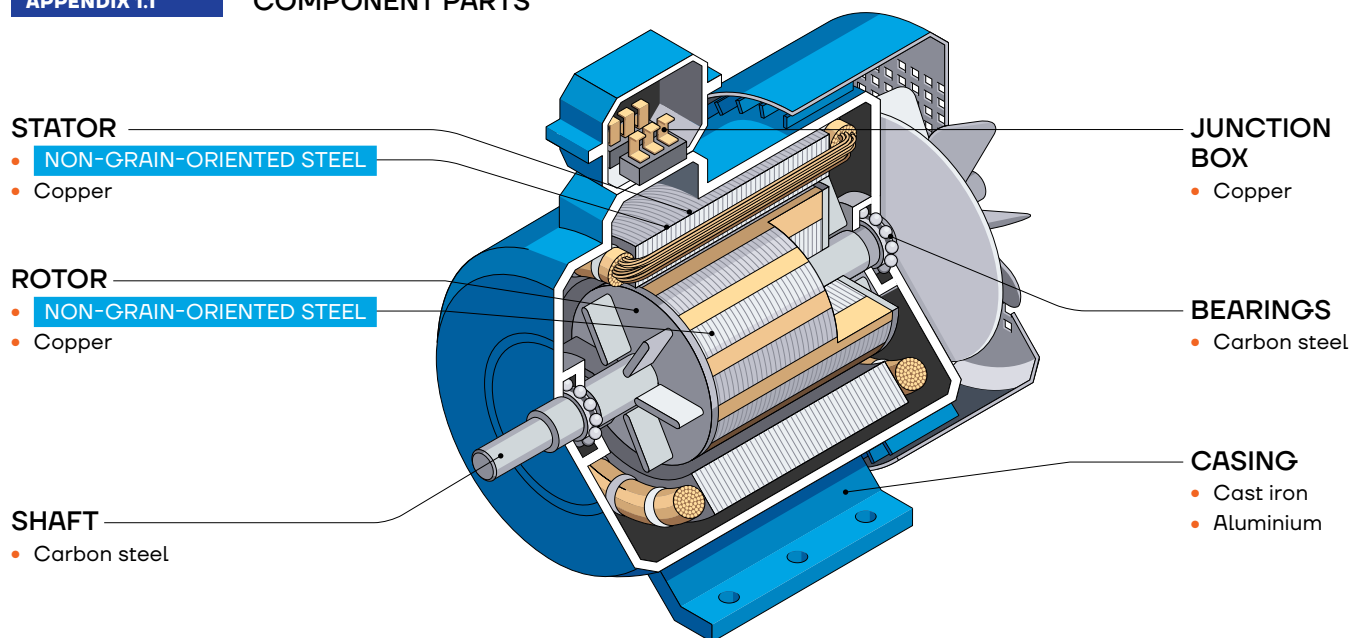
*** Марки в толщине 0,23 мм и с низкими магнитными потерями отсутствуют в GOST 32482, приведен аналог по стандарту НЛМК STO 05757665-008

APPENDIX 1

Examples of NGO steel in electric motors

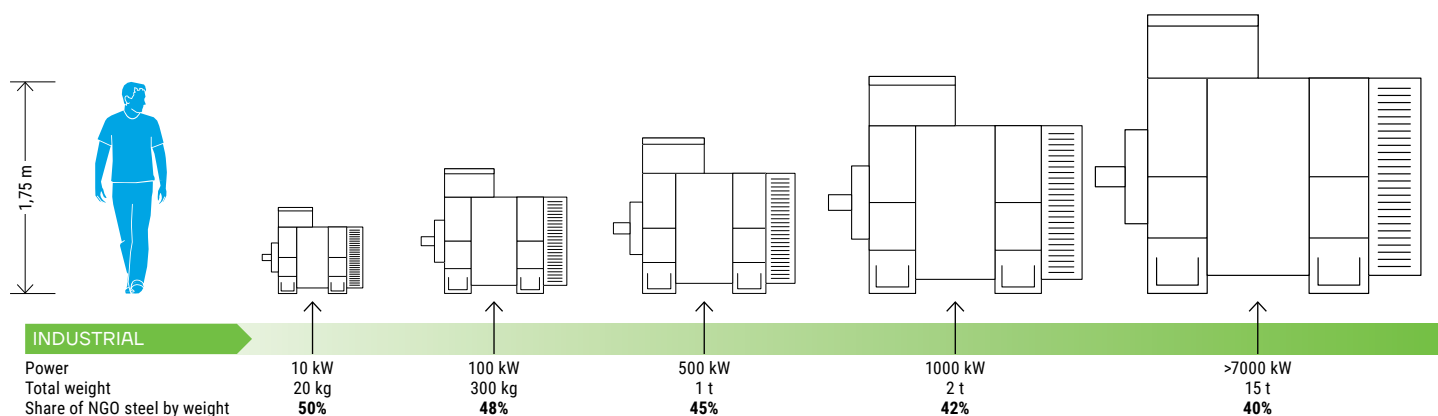
APPENDIX 1.1

COMPONENT PARTS



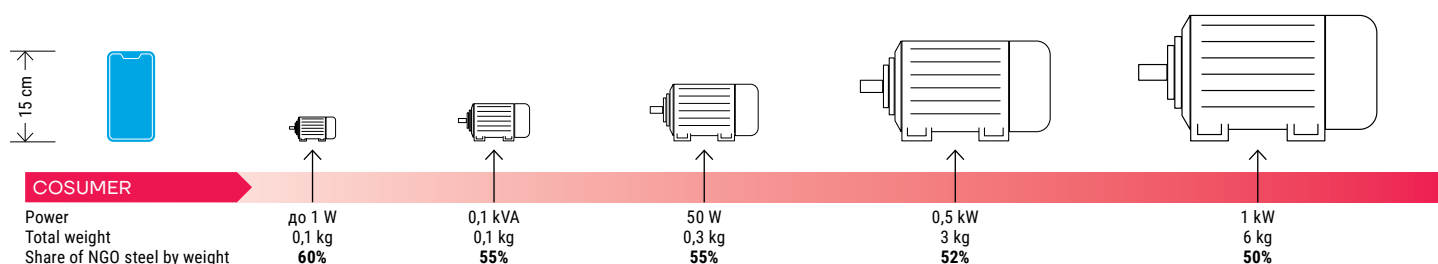
APPENDIX 1.2

POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



APPENDIX 1.3

POWER RANGE. CONSUMER IMPLEMENTATIONS

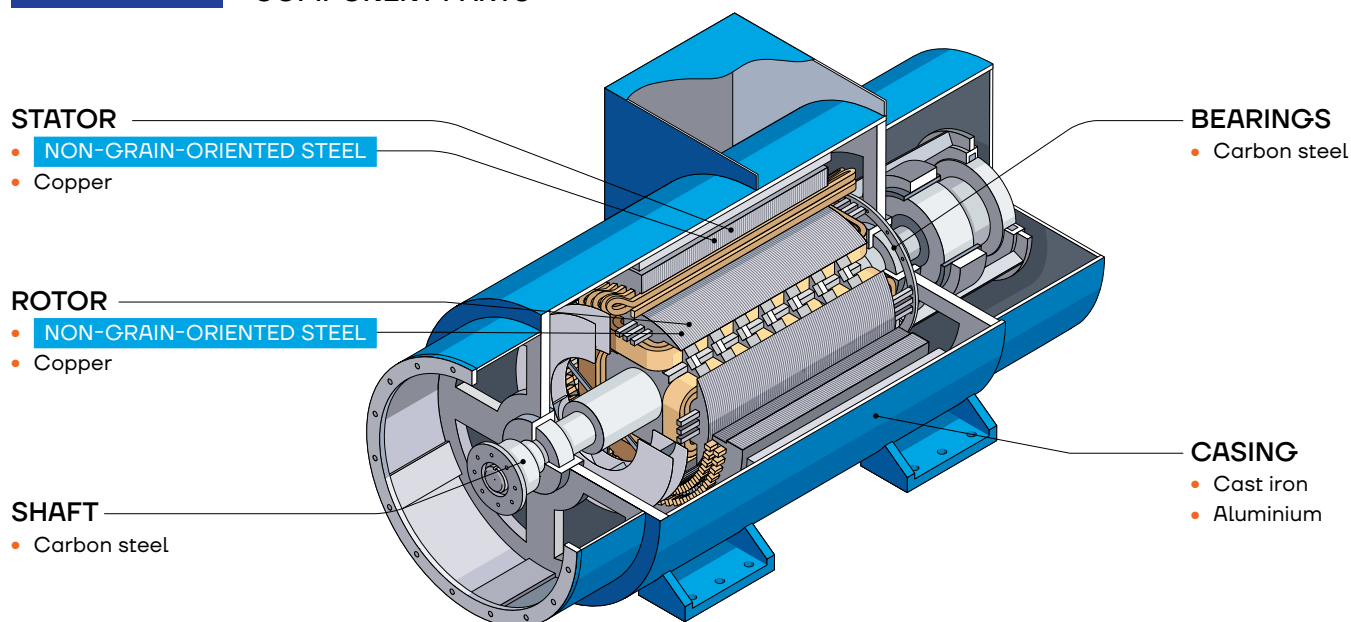


APPENDIX 2

Examples of NGO steel in electric generators

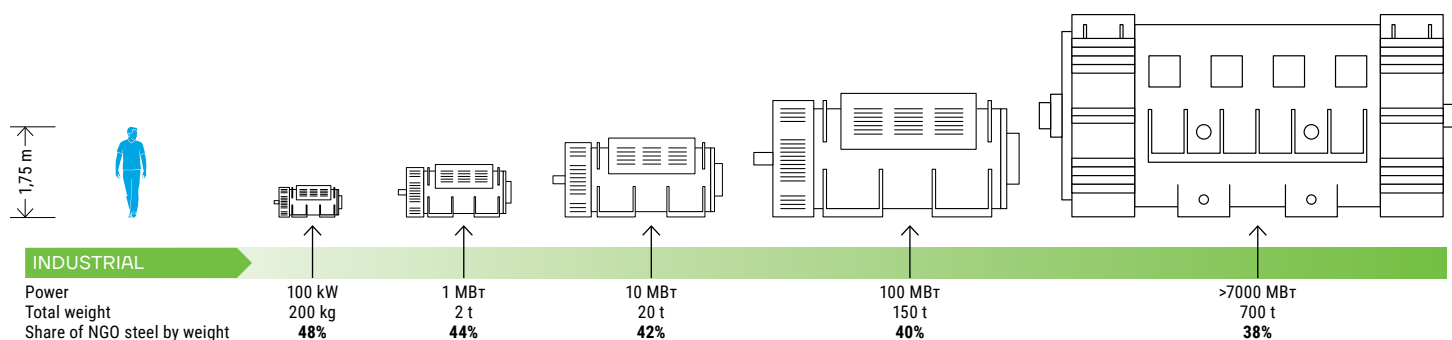
APPENDIX 2.1

COMPONENT PARTS



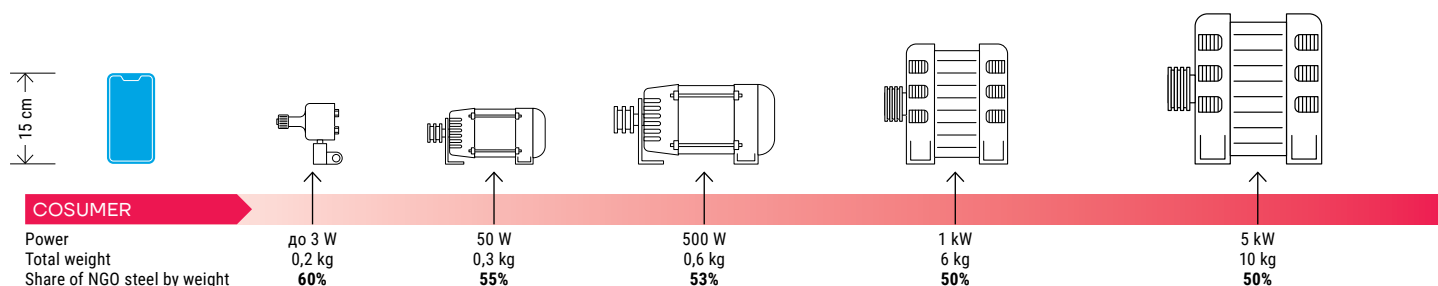
APPENDIX 2.2

POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



APPENDIX 2.3

POWER RANGE. CONSUMER IMPLEMENTATIONS



APPENDIX 3

Examples of electrical steel in transformers

APPENDIX 3.1

COMPONENT PARTS

MAGNETIC CORE

- ELECTRICAL STEEL

WINDING

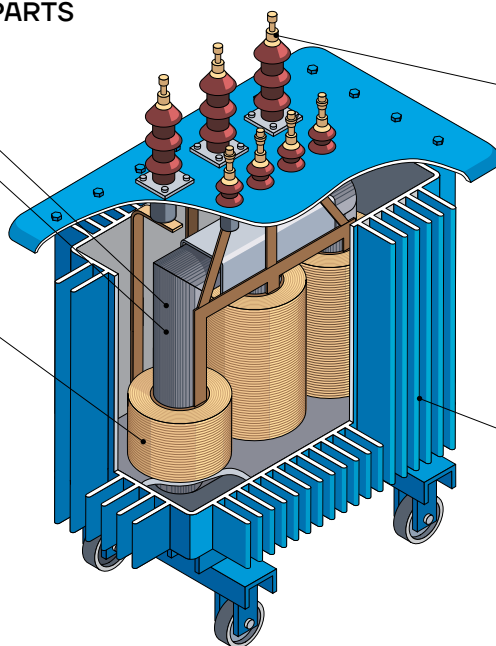
- Copper

WINDING TERMINAL

- Copper
- Porcelain

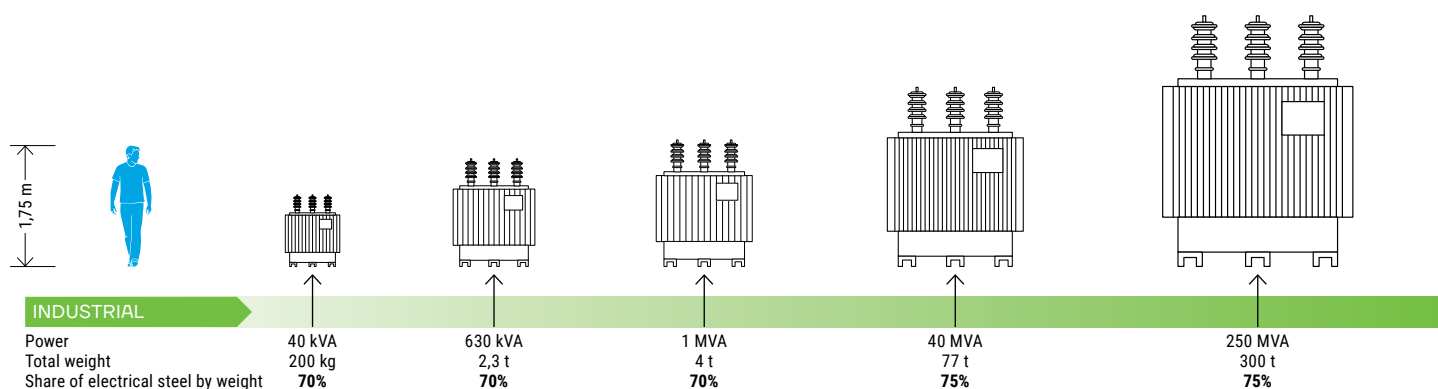
CASING

- Carbon steel



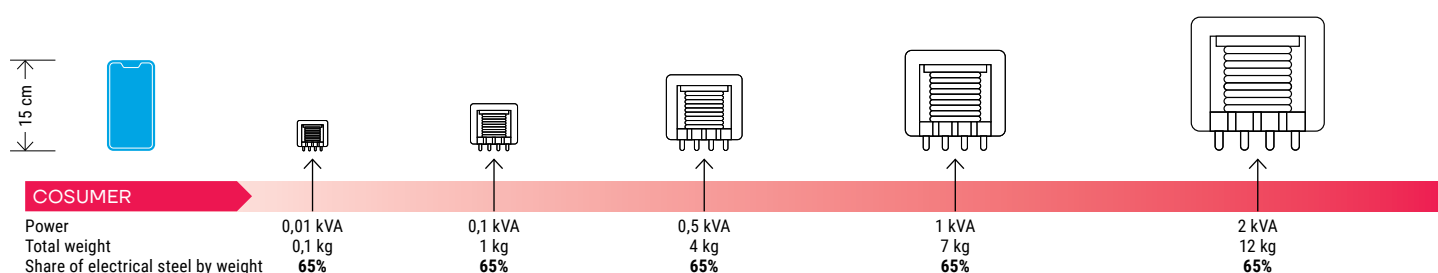
APPENDIX 3.2

POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



ПРИЛОЖЕНИЕ 3.3

POWER RANGE. CONSUMER IMPLEMENTATIONS

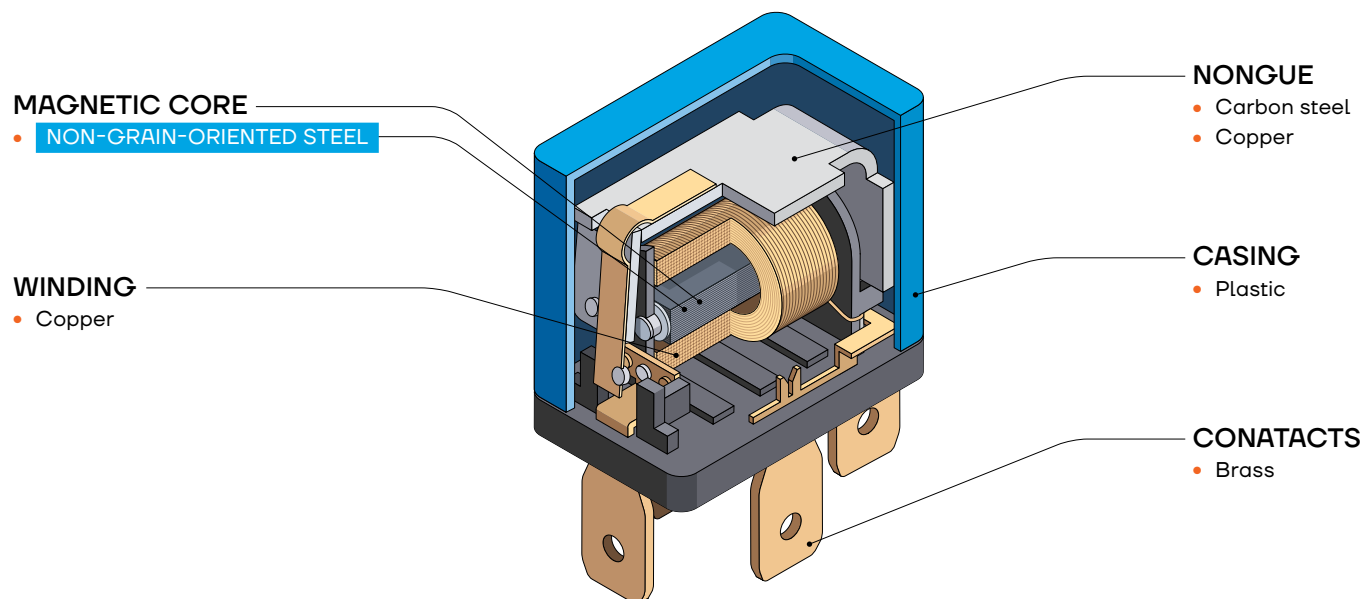


APPENDIX 4

Examples of NGO steel in relay switches

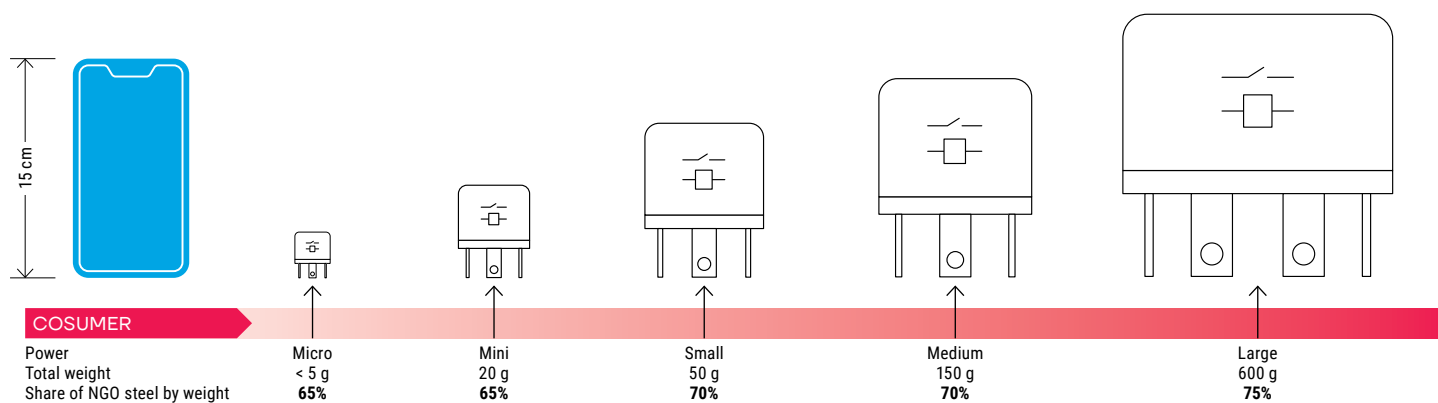
APPENDIX 4.1

COMPONENT PARTS



APPENDIX 4.2

POWER RANGE. CONSUMER IMPLEMENTATIONS



APPENDIX 5

Examples of NGO steel in induction coils

APPENDIX 6.1

COMPONENT PARTS

MAGNETIC CORE

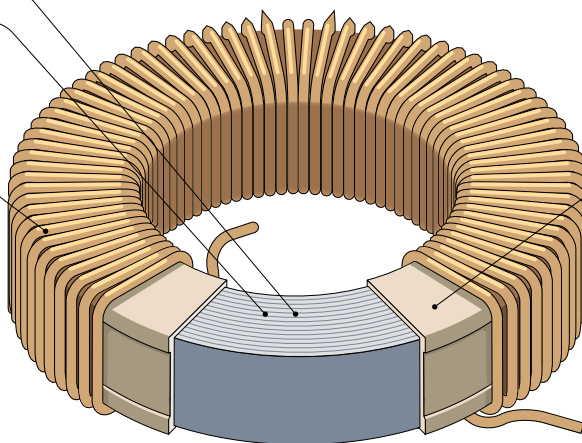
- NON-GRAIN-ORIENTED STEEL

WINDING

- Copper

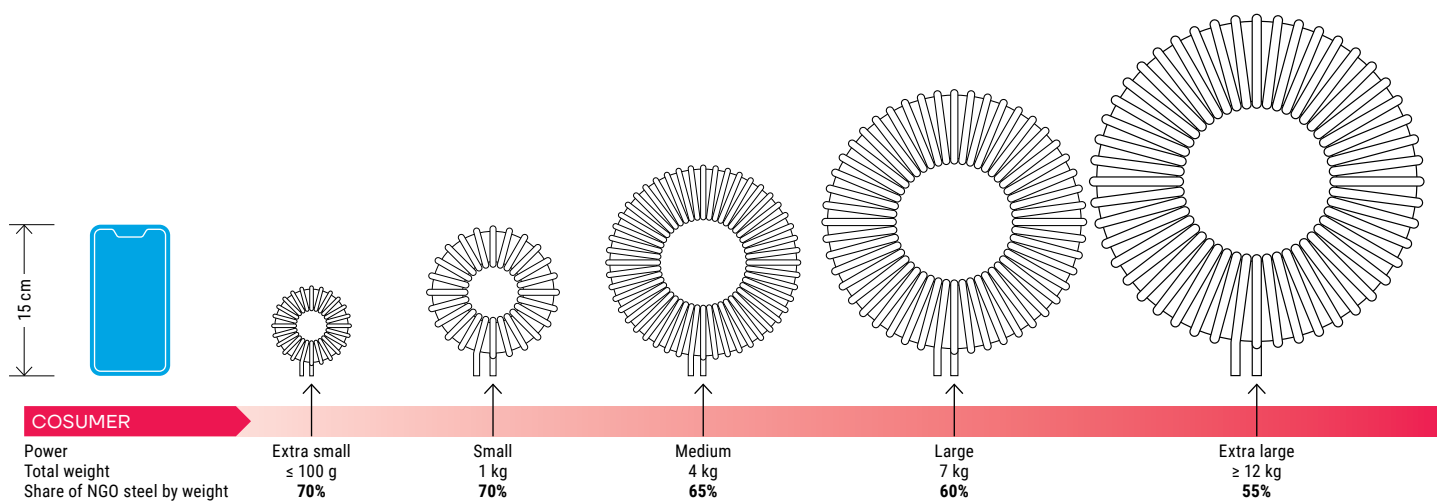
ISOLATION

- Paper
- Полимерный материал



APPENDIX 6.2

POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



APPENDIX 6

Examples of GOES in line reactors

APPENDIX 6.1

COMPONENT PARTS

MAGNETIC CORE

- GRAIN-ORIENTED STEEL

WINDING

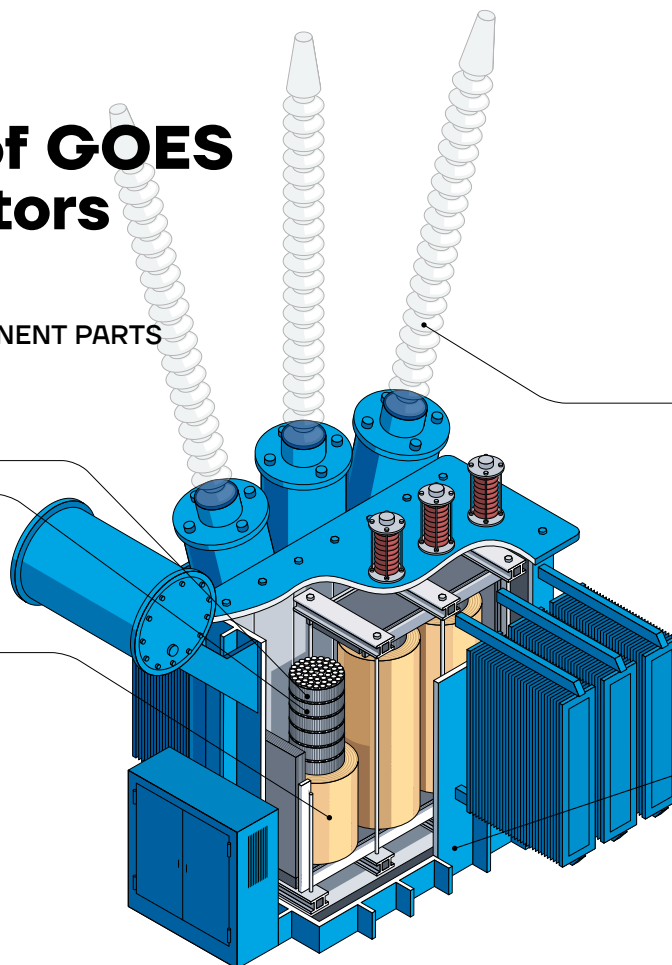
- Copper

WINDING TERMINAL

- Copper
- Porcelain

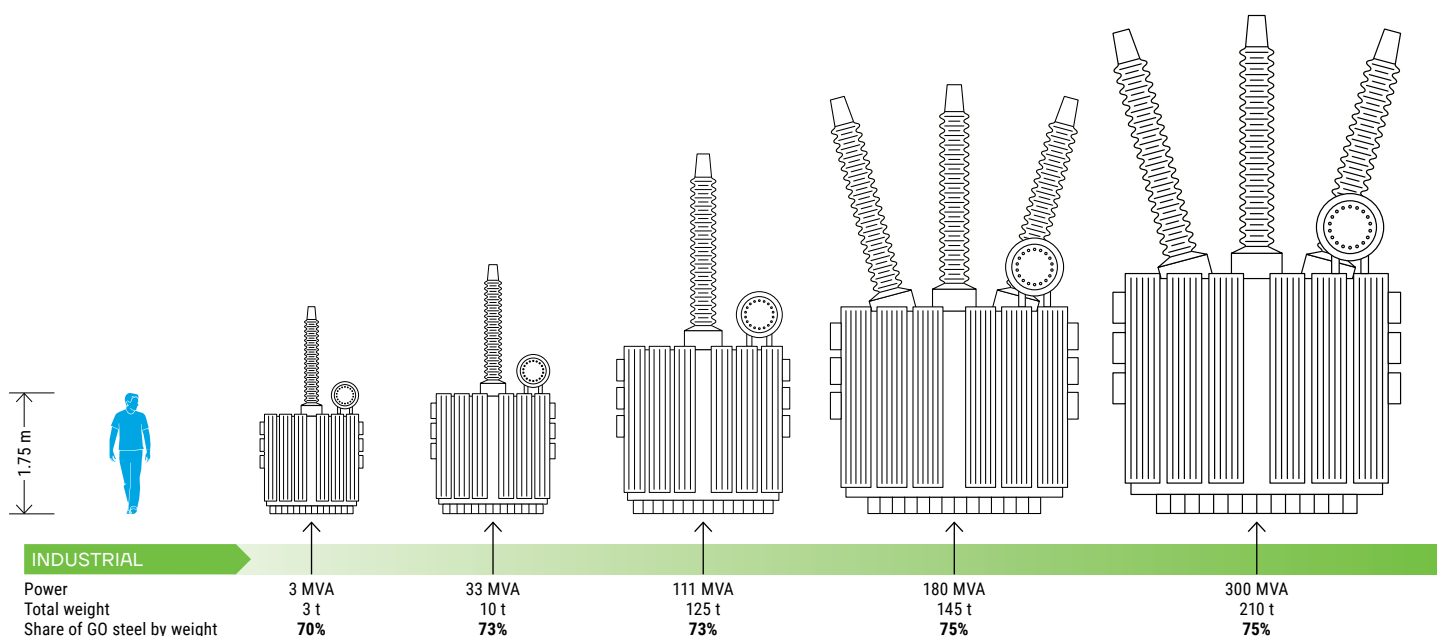
CASING

- Carbon steel



APPENDIX 6.2

POWER RANGE. EXAMPLE OF INDUSTRIAL IMPLEMENTATIONS



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